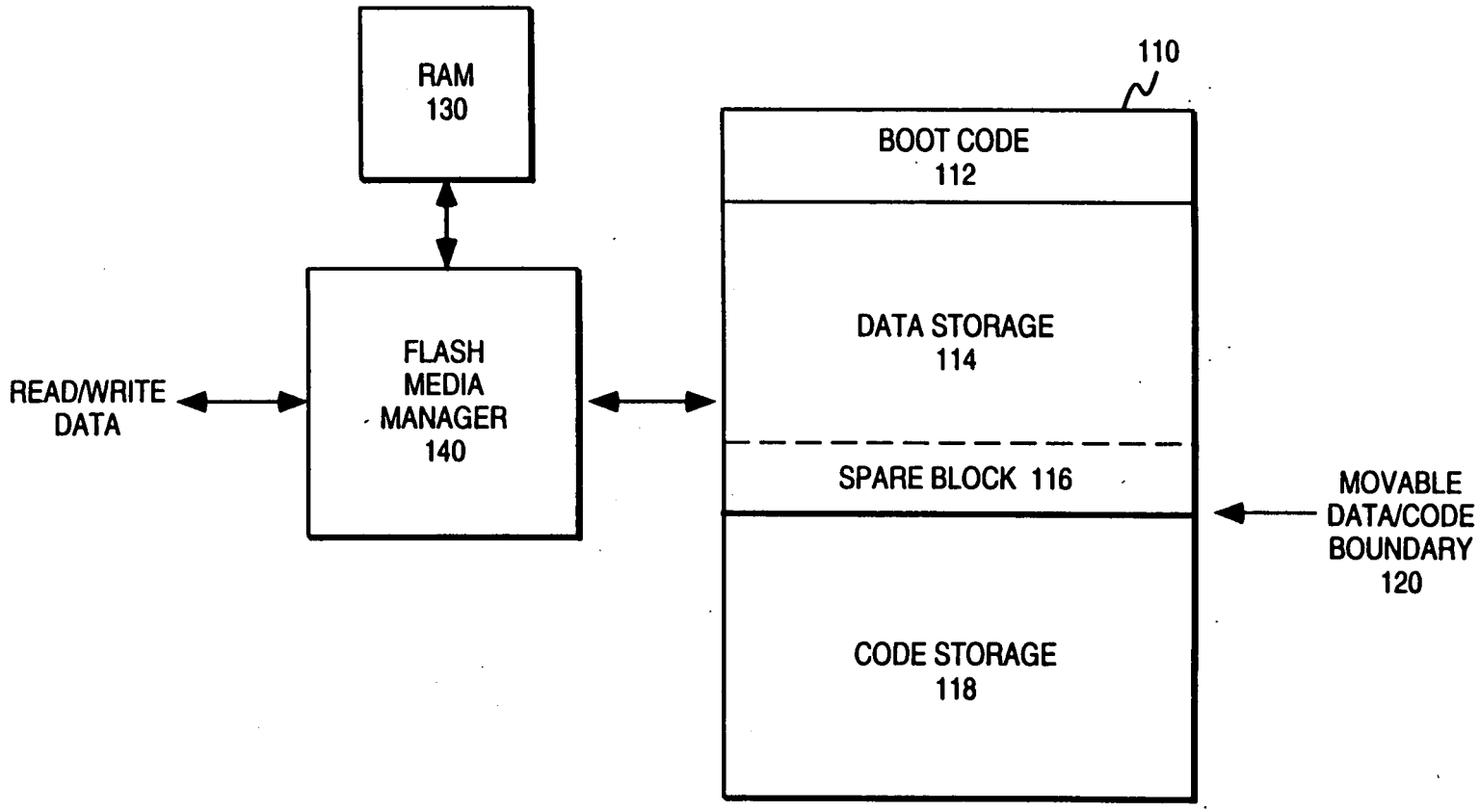

RAM
130
110
BOOT CODE
112
DATA STORAGE
114
FLASH
MEDIA
MANAGER
140
READ/WRITE
DATA
SPARE BLOCK 116
MOVABLE
DATA/CODE
BOUNDARY
120
CODE STORAGE
118

Figure 1

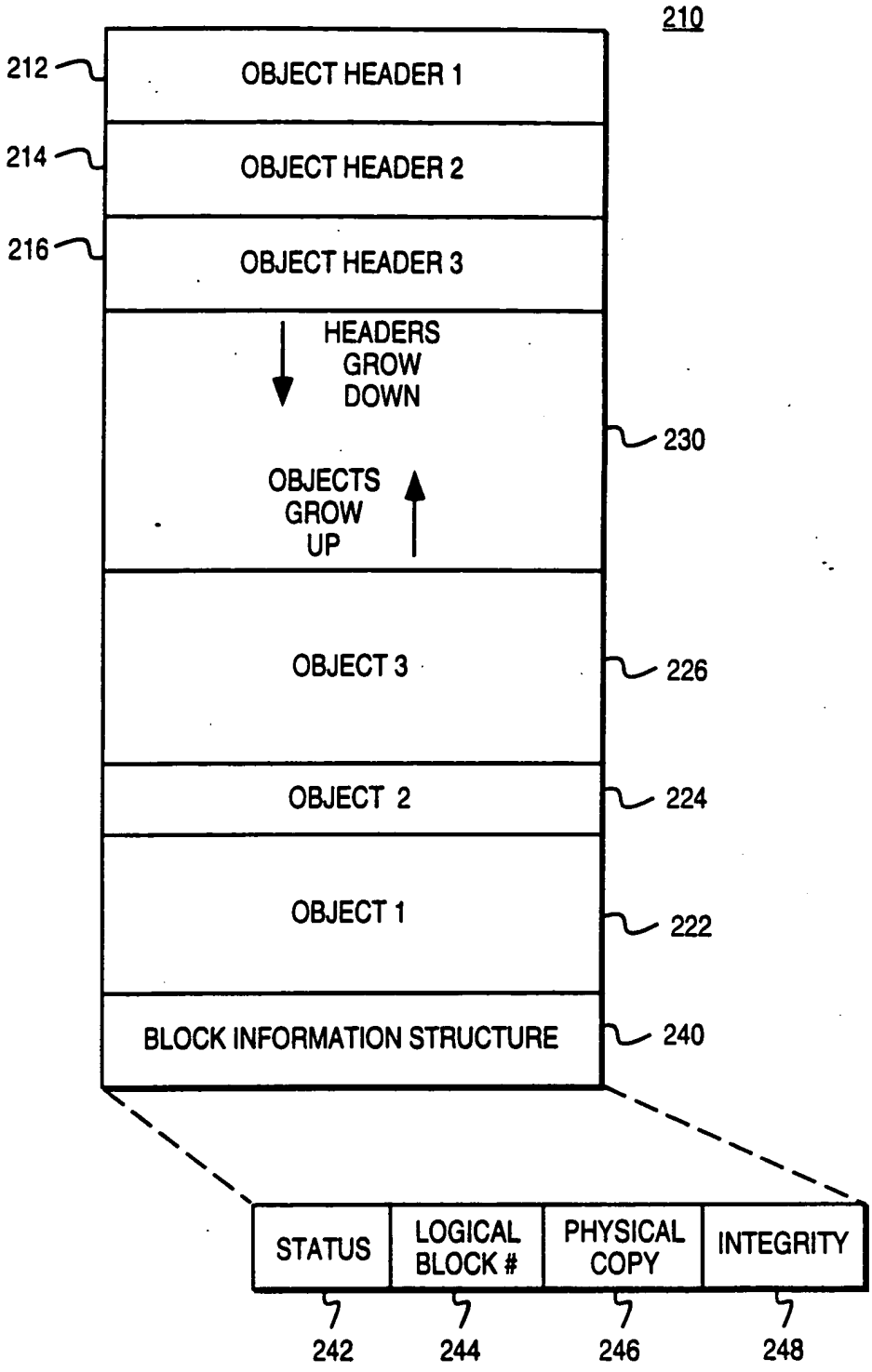

210
212
OBJECT HEADER 1
214
OBJECT HEADER 2
216
OBJECT HEADER 3
HEADERS GROW DOWN
OBJECTS GROW UP
230
OBJECT 3
226
OBJECT 2
224
OBJECT 1
222
BLOCK INFORMATION STRUCTURE
240
STATUS
LOGICAL BLOCK #
PHYSICAL COPY
INTEGRITY
242
244
246
248

Figure 2

OBJECT HEADER STRUCTURE

300

IDENTIFIER 302	STATUS 304	TYPE 306	SIZE 308	OFFSET 310	TABLE NUMBER 312

STATUS TABLE

320

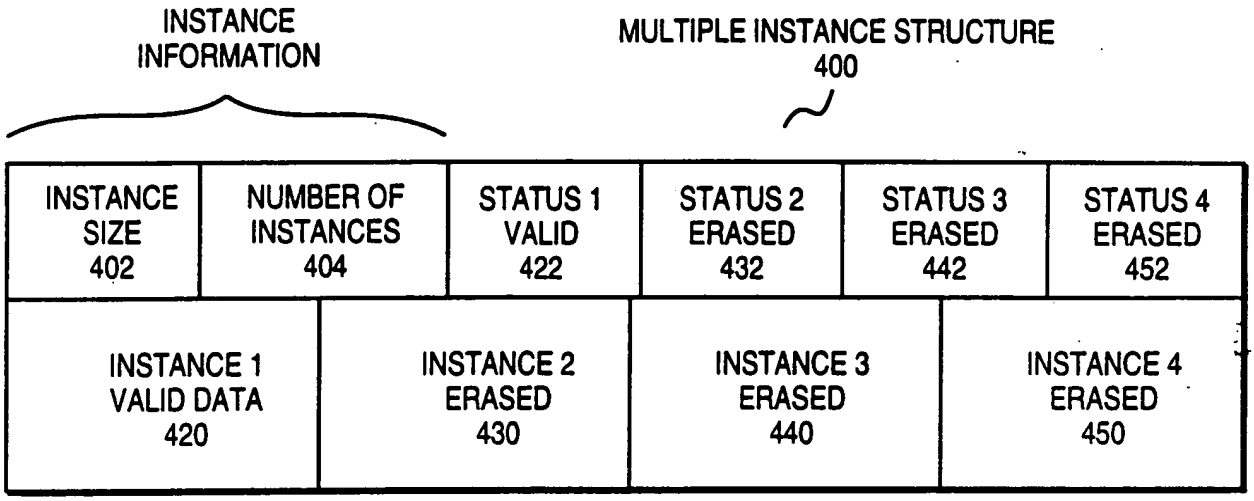
STATUS VALUE	NAME	DEFINITION
1111 1111	EMPTY	THIS IS AN EMPTY GRANULAR UNIT
0111 1111	ALLOCATING	HEADER BEING WRITTEN
0111 1110	HEADER WRITTEN	HEADER HAS BEEN WRITTEN
0011 1110	ALLOCATED	OBJECT DATA HAS BEEN WRITTEN
0001 1110	VALID	HEADER DESCRIBES VALID DATA
0000 1110	INVALIDATING	IN PROCESS OF DELETING GROUP TABLE
0000 0110	INVALID	HEADER DESCRIBES INVALID DATA

TYPE TABLE

330

TYPE VALUE	DEFINITION
XXXX 1110	HEADER POINTS TO MULTIPLE INSTANCE UNIT
XXXX 1100	HEADER POINTS TO A SEQUENCE TABLE
XXXX 1010	HEADER POINTS TO A GROUP TABLE
XXXX 1000	HEADER POINTS TO A SINGLE INSTANCE UNIT
XXXX 0000	HEADER PONTS TO A DATA FRAGMENT UNIT
0000 XXXX	THE DATA TYPE IS DATA PARAMETER
0001 XXXX	THE DATA TYPE IS DATA STREAM
0010 XXXX	THE DATA TYPE IS TELEPHONE NUMBER
0100 XXXX	THE DATA TYPE IS SHORT MESSAGE SERVICES (SMS)

Figure 3



460

INSTANCE STATUS

VALUE	STATUS	DEFINITION
1111	EMPTY	UNUSED DATA INSTANCE
0111	ALLOCATING	INSTANCE BEING WRITTEN
0101	INVALIDATE	INVALIDATION IN PROGRESS
0011	ALLOCATED	INSTANCE BEING WRITTEN
0001	VALID	INSTANCE HOLDS VALID DATA
0000	INVALID	INSTANCE DOES NOT HOLD VALID DATA

Figure 4

510

ENTRY STRUCTURE FOR GROUP/SEQUENCE TABLES

BLOCK NUMBER 512	ENTRY STATUS 514	ENTRY INSTANCE 516	ENTRY SIZE 518	OLD ENTRY SIZE 520	PHYSICAL INDEX 522

ENTRY STATUS

560

VALUE	STATUS	DEFINITION
1111	EMPTY	ENTRY AVAILABLE
0111	ALLOCATING	ENTRY BEING WRITTEN
0011	ENTRY WRITTEN	ENTRY HAS BEEN WRITTEN
0001	VALID	ENTRY DESCRIBES VALID DATA
0101	INVALIDATE	USED DURING POWER LOSS RECOVERY

Figure 5

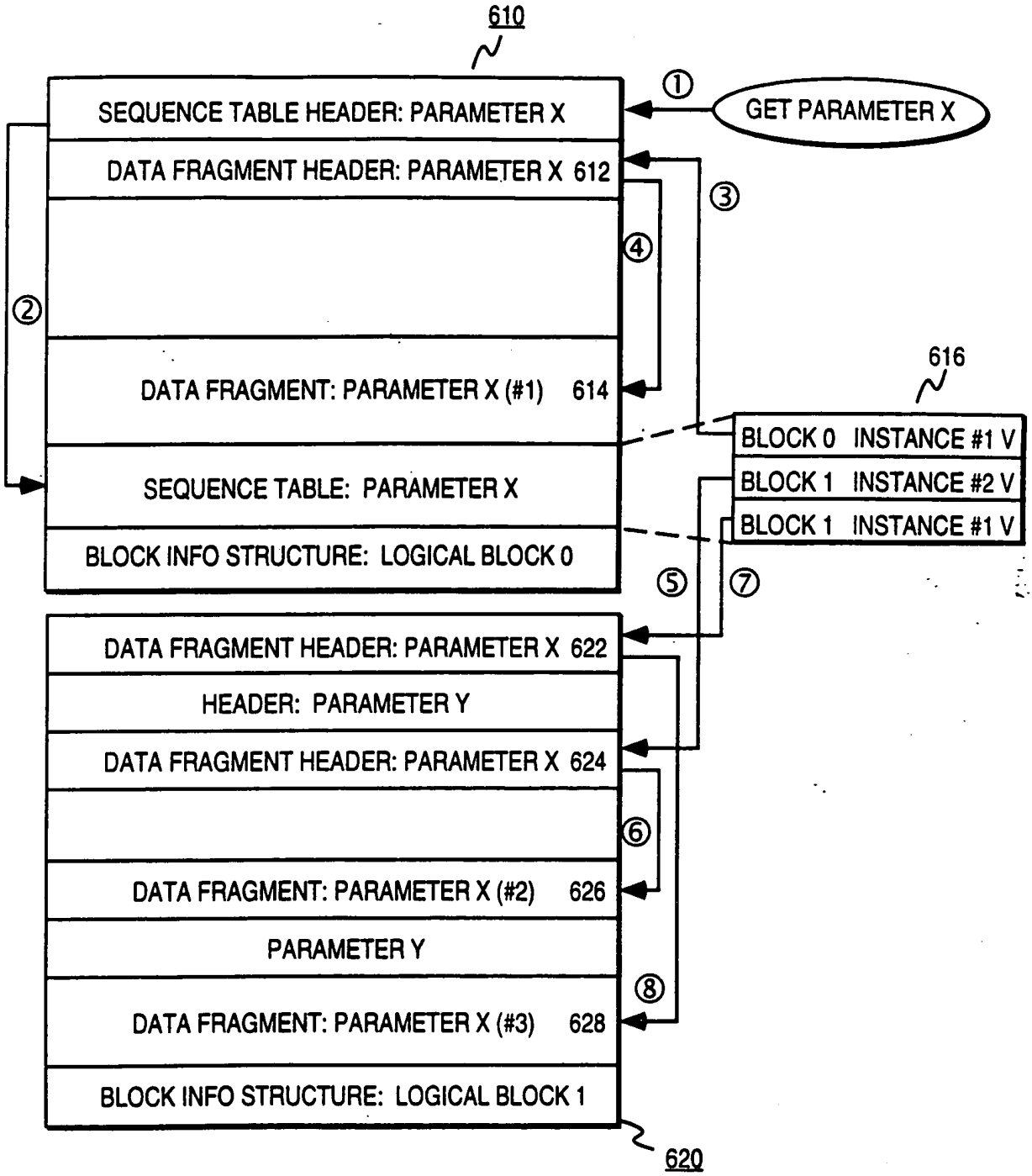

610
SEQUENCE TABLE HEADER: PARAMETER X
GET PARAMETER X
DATA FRAGMENT HEADER: PARAMETER X 612
DATA FRAGMENT: PARAMETER X (#1) 614
SEQUENCE TABLE: PARAMETER X
BLOCK INFO STRUCTURE: LOGICAL BLOCK 0
616
BLOCK 0 INSTANCE #1 V
BLOCK 1 INSTANCE #2 V
BLOCK 1 INSTANCE #1 V
DATA FRAGMENT HEADER: PARAMETER X 622
HEADER: PARAMETER Y
DATA FRAGMENT HEADER: PARAMETER X 624
DATA FRAGMENT: PARAMETER X (#2) 626
PARAMETER Y
DATA FRAGMENT: PARAMETER X (#3) 628
BLOCK INFO STRUCTURE: LOGICAL BLOCK 1
620
①
②
③
④
⑤
⑥
⑦
⑧

Figure 6

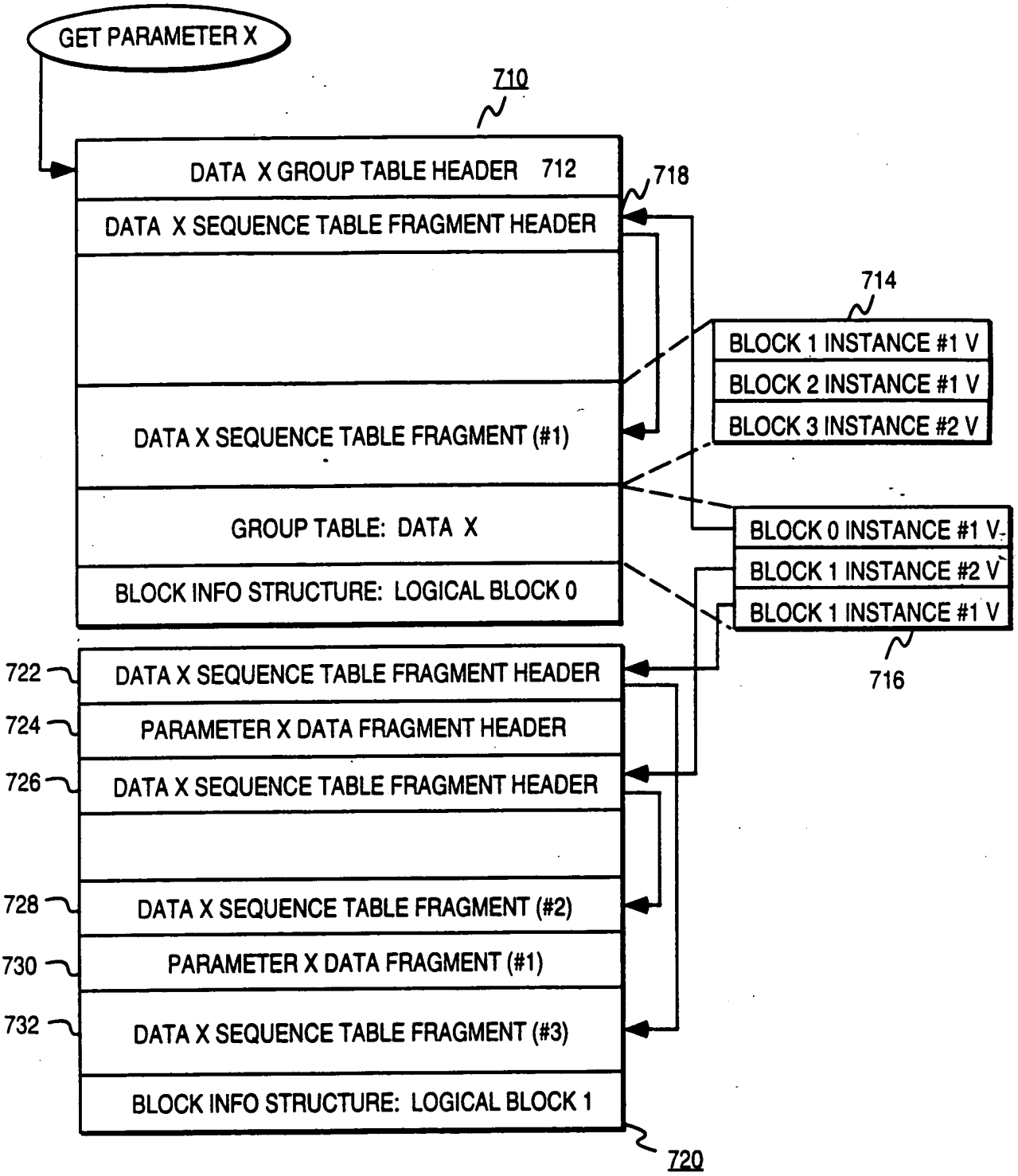

GET PARAMETER X
710
DATA X GROUP TABLE HEADER 712
718
DATA X SEQUENCE TABLE FRAGMENT HEADER
714
DATA X SEQUENCE TABLE FRAGMENT (#1)
BLOCK 1 INSTANCE #1 V
BLOCK 2 INSTANCE #1 V
BLOCK 3 INSTANCE #2 V
GROUP TABLE: DATA X
BLOCK 0 INSTANCE #1 V
BLOCK 1 INSTANCE #2 V
BLOCK 1 INSTANCE #1 V
716
BLOCK INFO STRUCTURE: LOGICAL BLOCK 0
722
DATA X SEQUENCE TABLE FRAGMENT HEADER
724
PARAMETER X DATA FRAGMENT HEADER
726
DATA X SEQUENCE TABLE FRAGMENT HEADER
728
DATA X SEQUENCE TABLE FRAGMENT (#2)
730
PARAMETER X DATA FRAGMENT (#1)
732
DATA X SEQUENCE TABLE FRAGMENT (#3)
BLOCK INFO STRUCTURE: LOGICAL BLOCK 1
720

Figure 7

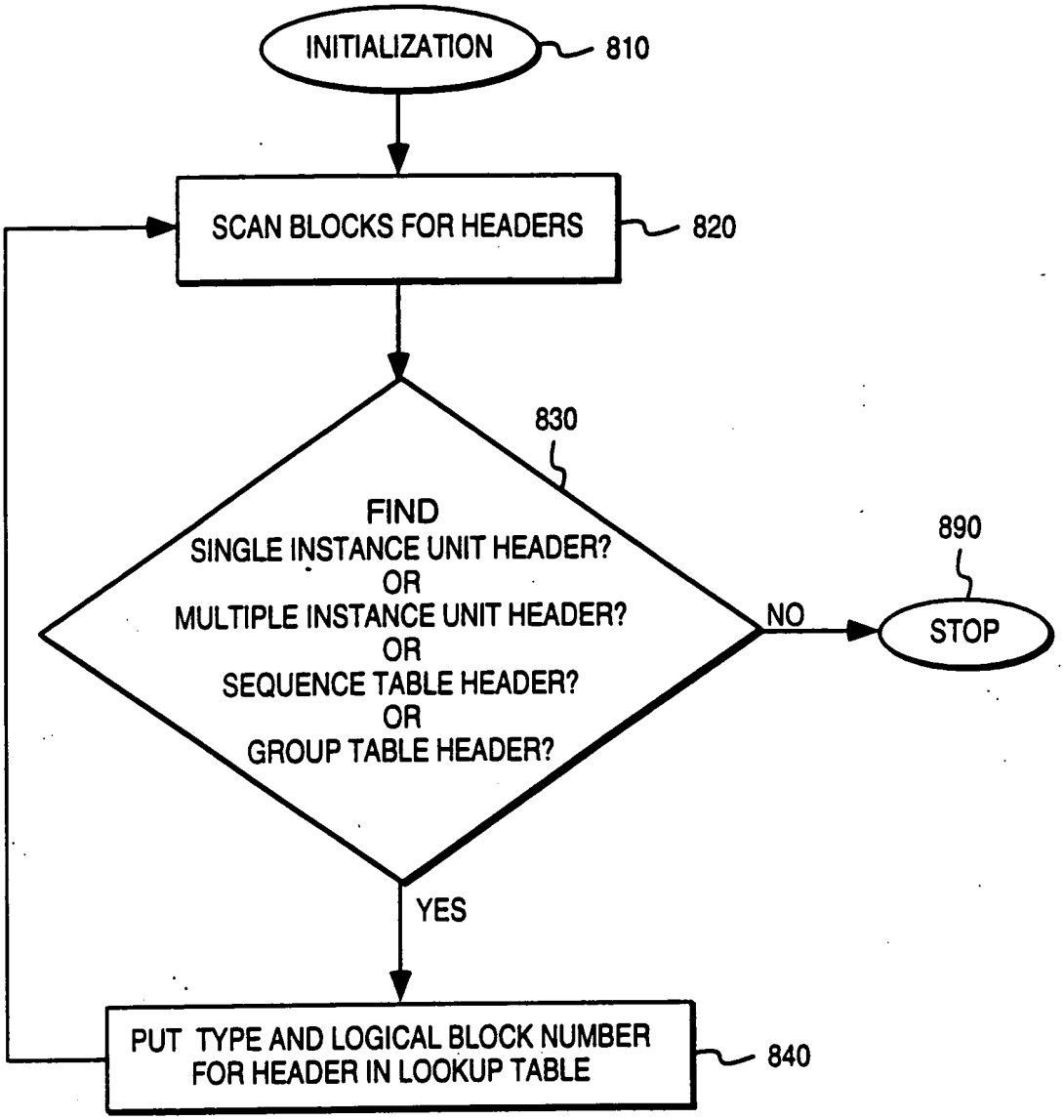

INITIALIZATION
810
SCAN BLOCKS FOR HEADERS
820
830
FIND
SINGLE INSTANCE UNIT HEADER?
OR
MULTIPLE INSTANCE UNIT HEADER?
OR
SEQUENCE TABLE HEADER?
OR
GROUP TABLE HEADER?
NO
890
STOP
YES
PUT TYPE AND LOGICAL BLOCK NUMBER
FOR HEADER IN LOOKUP TABLE
840

Figure 8

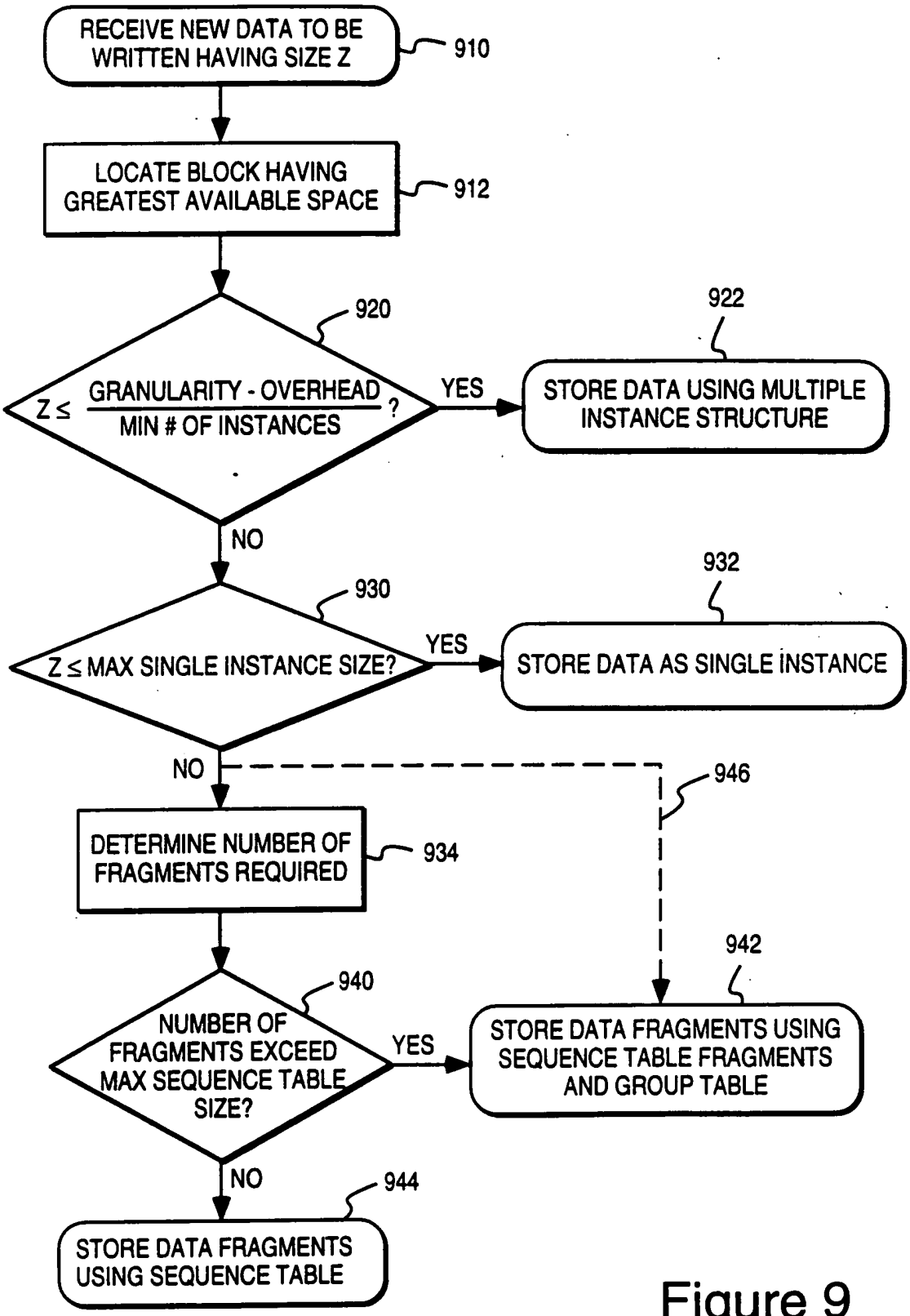

RECEIVE NEW DATA TO BE WRITTEN HAVING SIZE Z
910
LOCATE BLOCK HAVING GREATEST AVAILABLE SPACE
912
920
Z ≤ GRANULARITY - OVERHEAD / MIN # OF INSTANCES ?
YES
922
STORE DATA USING MULTIPLE INSTANCE STRUCTURE
NO
930
Z ≤ MAX SINGLE INSTANCE SIZE?
YES
932
STORE DATA AS SINGLE INSTANCE
NO
946
DETERMINE NUMBER OF FRAGMENTS REQUIRED
934
940
NUMBER OF FRAGMENTS EXCEED MAX SEQUENCE TABLE SIZE?
YES
942
STORE DATA FRAGMENTS USING SEQUENCE TABLE FRAGMENTS AND GROUP TABLE
NO
944
STORE DATA FRAGMENTS USING SEQUENCE TABLE

Figure 9

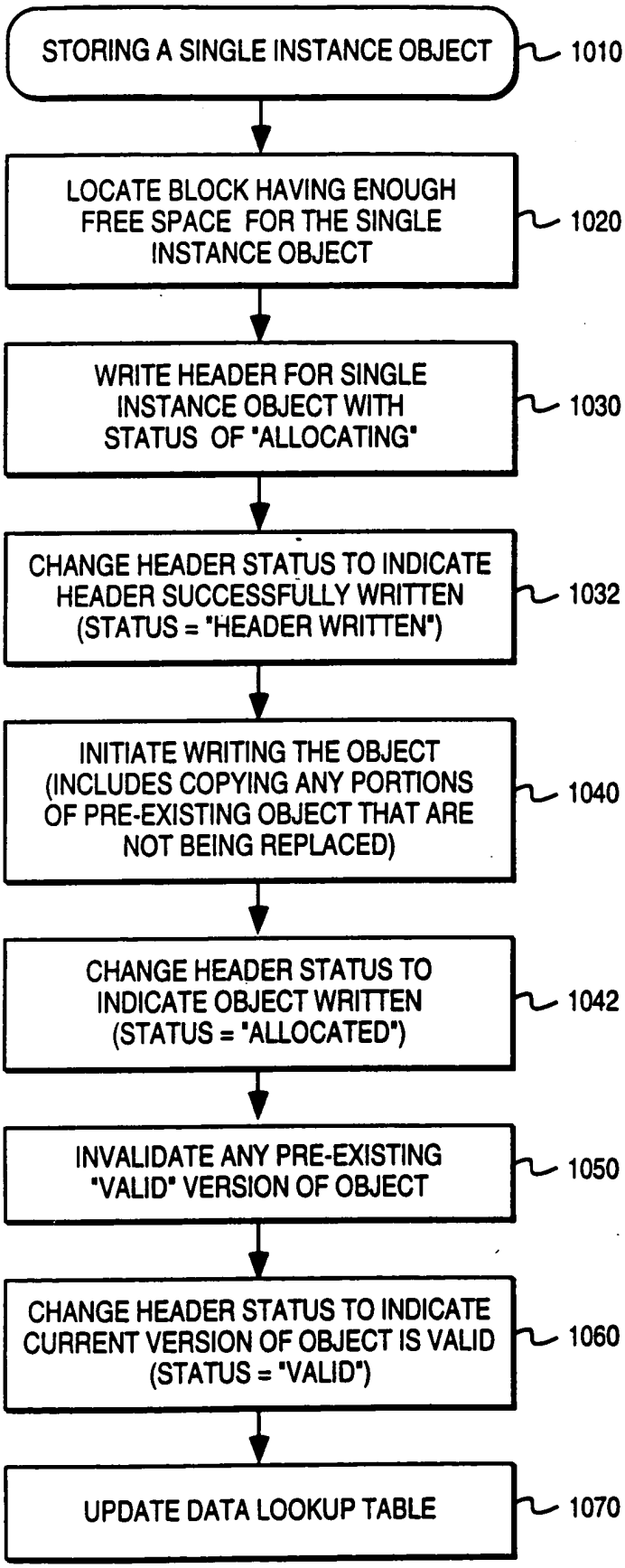

STORING A SINGLE INSTANCE OBJECT
1010
LOCATE BLOCK HAVING ENOUGH FREE SPACE FOR THE SINGLE INSTANCE OBJECT
1020
WRITE HEADER FOR SINGLE INSTANCE OBJECT WITH STATUS OF "ALLOCATING"
1030
CHANGE HEADER STATUS TO INDICATE HEADER SUCCESSFULLY WRITTEN (STATUS = "HEADER WRITTEN")
1032
INITIATE WRITING THE OBJECT (INCLUDES COPYING ANY PORTIONS OF PRE-EXISTING OBJECT THAT ARE NOT BEING REPLACED)
1040
CHANGE HEADER STATUS TO INDICATE OBJECT WRITTEN (STATUS = "ALLOCATED")
1042
INVALIDATE ANY PRE-EXISTING "VALID" VERSION OF OBJECT
1050
CHANGE HEADER STATUS TO INDICATE CURRENT VERSION OF OBJECT IS VALID (STATUS = "VALID")
1060
UPDATE DATA LOOKUP TABLE
1070

Figure 10

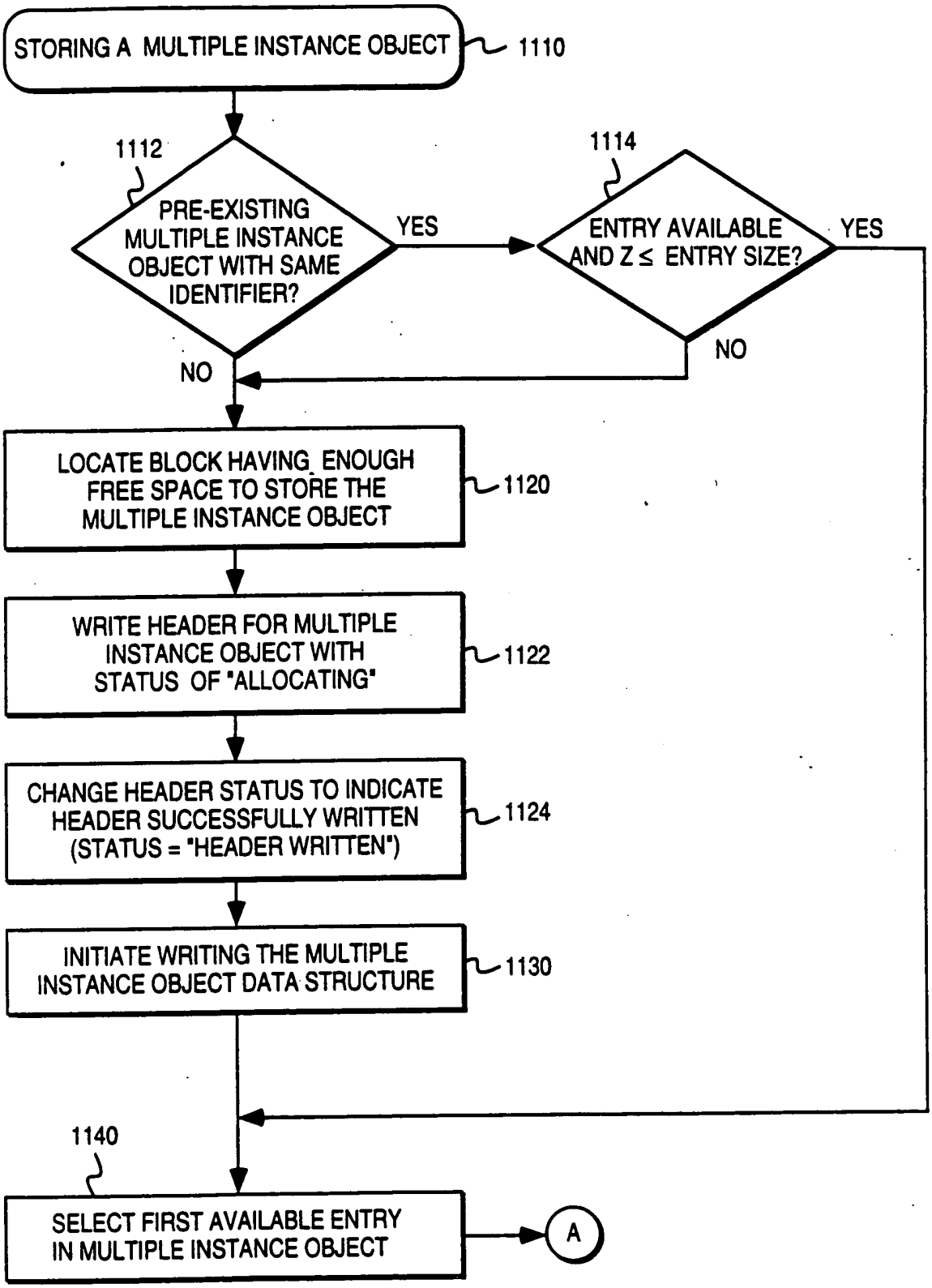

STORING A MULTIPLE INSTANCE OBJECT
1110
1112
PRE-EXISTING MULTIPLE INSTANCE OBJECT WITH SAME IDENTIFIER?
YES
1114
ENTRY AVAILABLE AND Z ≤ ENTRY SIZE?
YES
NO
NO
LOCATE BLOCK HAVING ENOUGH FREE SPACE TO STORE THE MULTIPLE INSTANCE OBJECT
1120
WRITE HEADER FOR MULTIPLE INSTANCE OBJECT WITH STATUS OF "ALLOCATING"
1122
CHANGE HEADER STATUS TO INDICATE HEADER SUCCESSFULLY WRITTEN (STATUS = "HEADER WRITTEN")
1124
INITIATE WRITING THE MULTIPLE INSTANCE OBJECT DATA STRUCTURE
1130
1140
SELECT FIRST AVAILABLE ENTRY IN MULTIPLE INSTANCE OBJECT
A

Figure 11

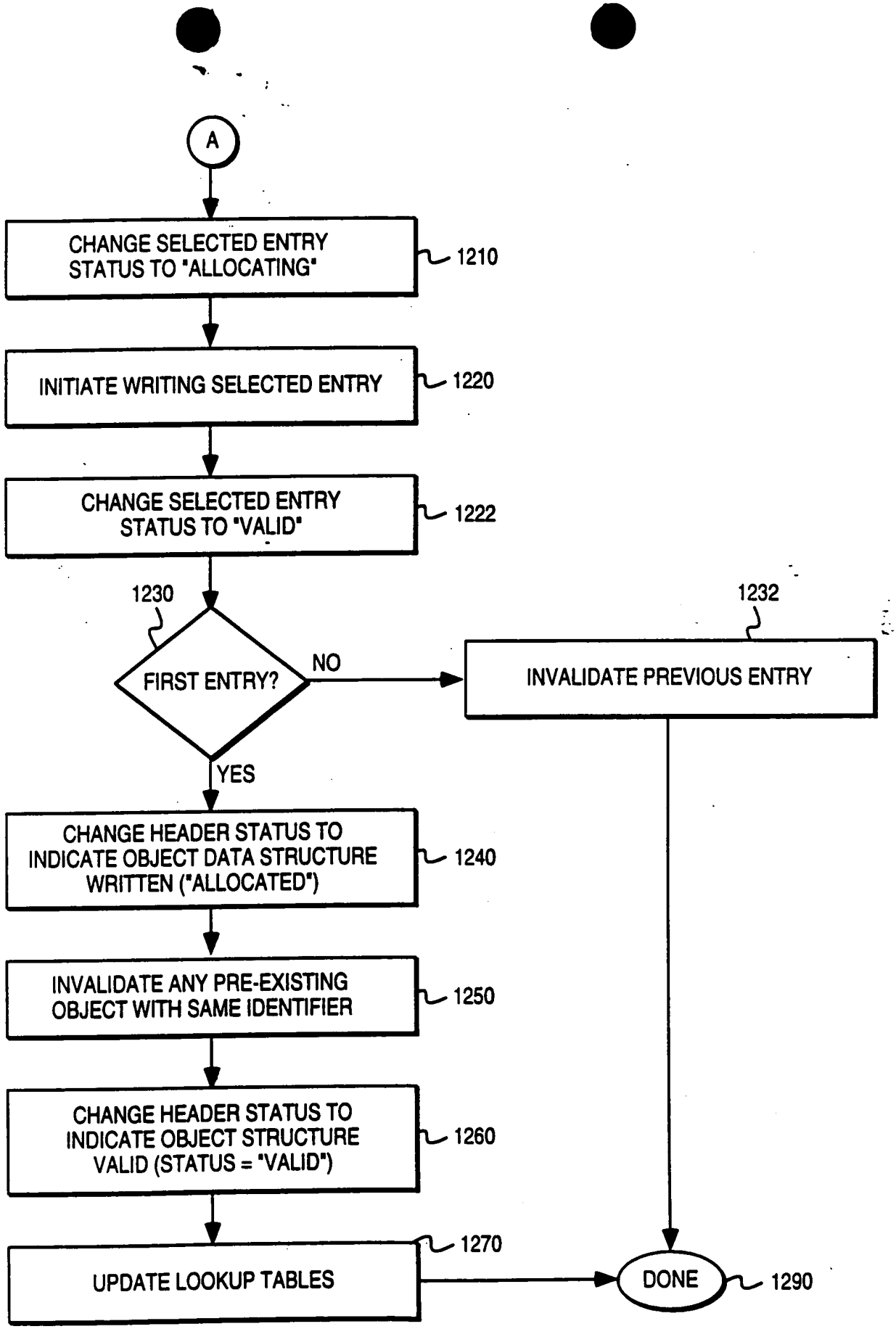

A
CHANGE SELECTED ENTRY STATUS TO "ALLOCATING"
1210
INITIATE WRITING SELECTED ENTRY
1220
CHANGE SELECTED ENTRY STATUS TO "VALID"
1222
1230
FIRST ENTRY?
NO
1232
INVALIDATE PREVIOUS ENTRY
YES
CHANGE HEADER STATUS TO INDICATE OBJECT DATA STRUCTURE WRITTEN ("ALLOCATED")
1240
INVALIDATE ANY PRE-EXISTING OBJECT WITH SAME IDENTIFIER
1250
CHANGE HEADER STATUS TO INDICATE OBJECT STRUCTURE VALID (STATUS = "VALID")
1260
1270
UPDATE LOOKUP TABLES
DONE
1290

Figure 12

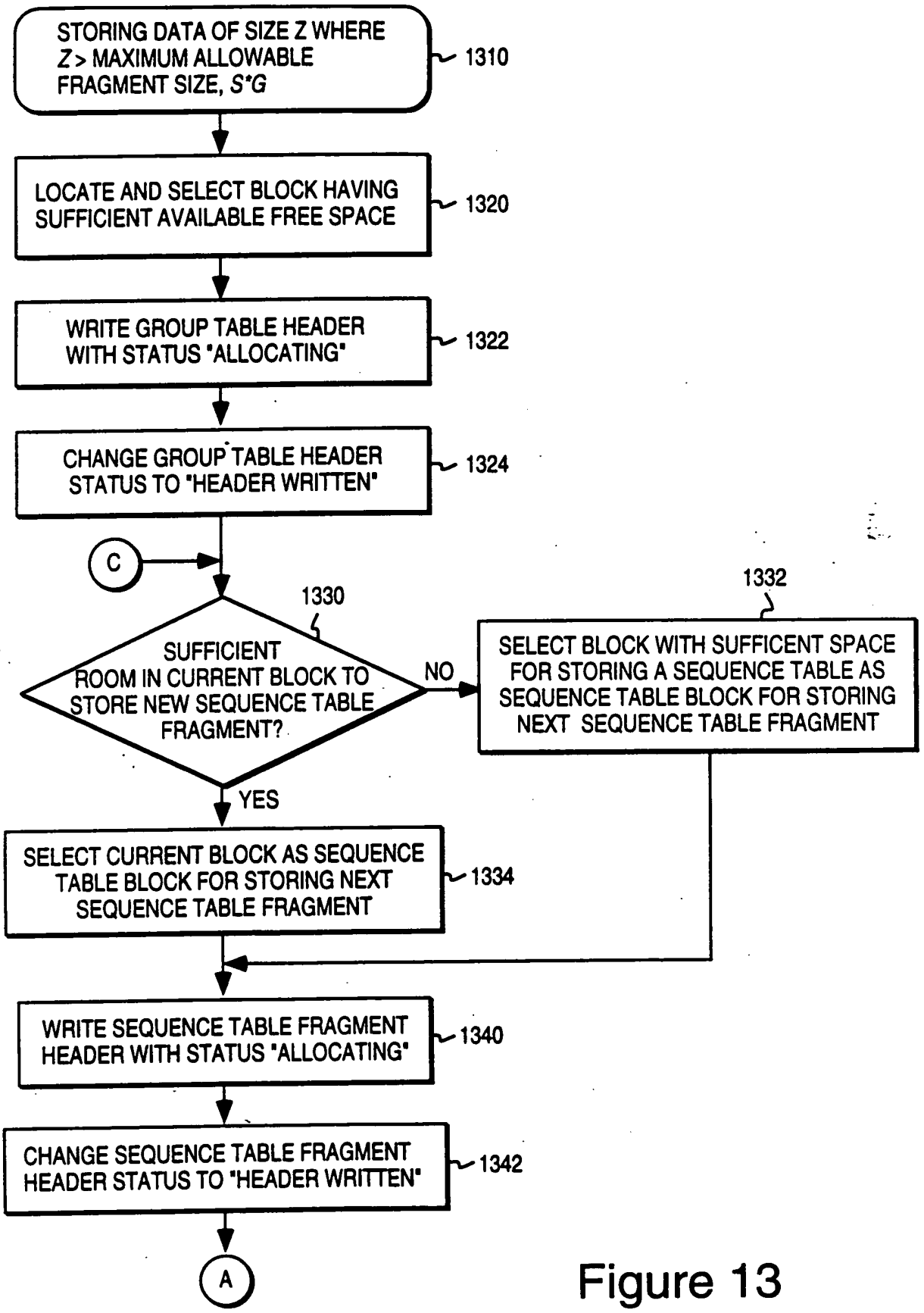

STORING DATA OF SIZE Z WHERE Z > MAXIMUM ALLOWABLE FRAGMENT SIZE, S*G
1310
LOCATE AND SELECT BLOCK HAVING SUFFICIENT AVAILABLE FREE SPACE
1320
WRITE GROUP TABLE HEADER WITH STATUS "ALLOCATING"
1322
CHANGE GROUP TABLE HEADER STATUS TO "HEADER WRITTEN"
1324
C
1330
SUFFICIENT ROOM IN CURRENT BLOCK TO STORE NEW SEQUENCE TABLE FRAGMENT?
NO
1332
SELECT BLOCK WITH SUFFICENT SPACE FOR STORING A SEQUENCE TABLE AS SEQUENCE TABLE BLOCK FOR STORING NEXT SEQUENCE TABLE FRAGMENT
YES
SELECT CURRENT BLOCK AS SEQUENCE TABLE BLOCK FOR STORING NEXT SEQUENCE TABLE FRAGMENT
1334
WRITE SEQUENCE TABLE FRAGMENT HEADER WITH STATUS "ALLOCATING"
1340
CHANGE SEQUENCE TABLE FRAGMENT HEADER STATUS TO "HEADER WRITTEN"
1342
A

Figure 13

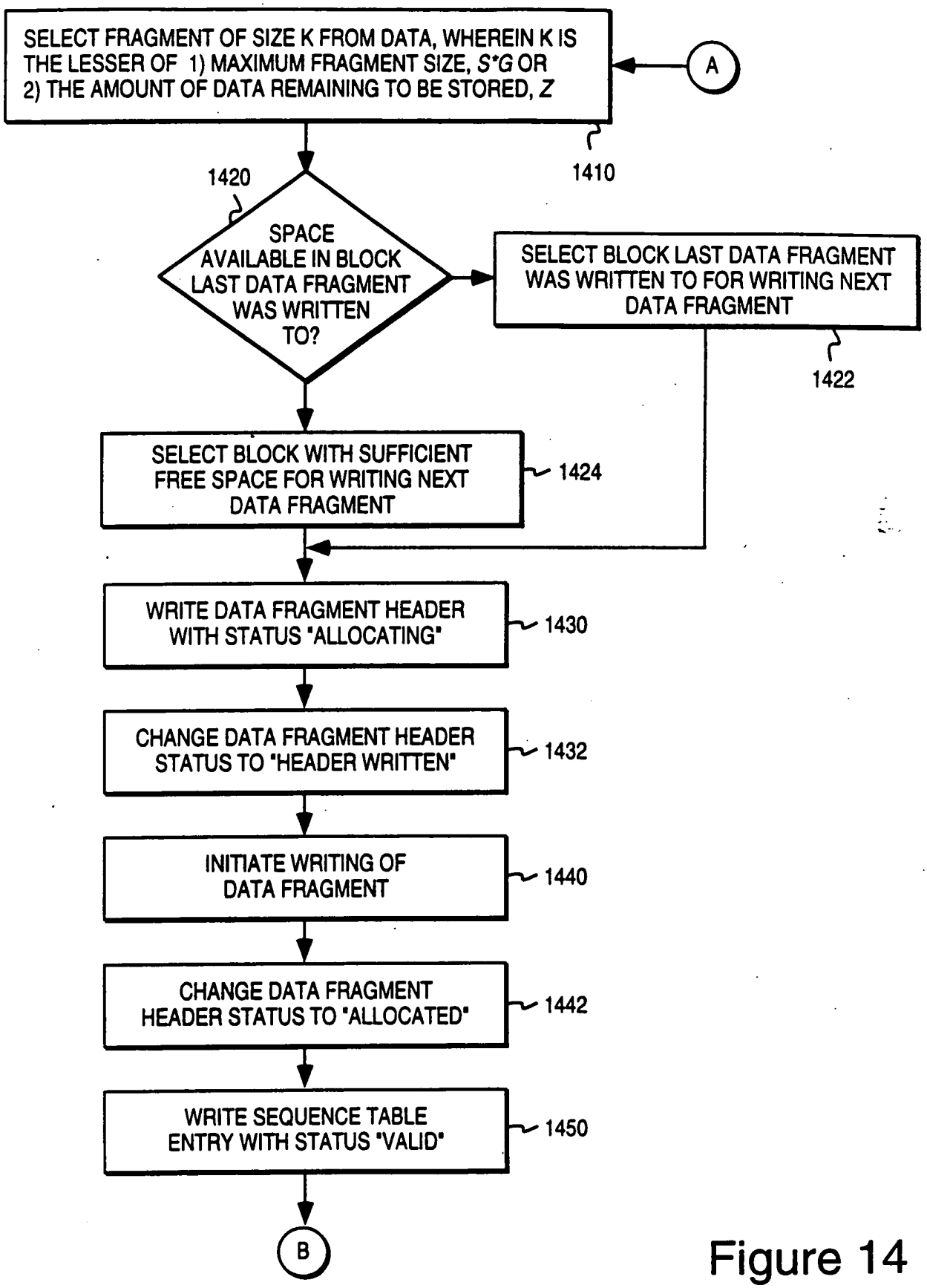

SELECT FRAGMENT OF SIZE K FROM DATA, WHEREIN K IS THE LESSER OF 1) MAXIMUM FRAGMENT SIZE, S*G OR 2) THE AMOUNT OF DATA REMAINING TO BE STORED, Z
A
1410
1420
SPACE AVAILABLE IN BLOCK LAST DATA FRAGMENT WAS WRITTEN TO?
SELECT BLOCK LAST DATA FRAGMENT WAS WRITTEN TO FOR WRITING NEXT DATA FRAGMENT
1422
SELECT BLOCK WITH SUFFICIENT FREE SPACE FOR WRITING NEXT DATA FRAGMENT
1424
WRITE DATA FRAGMENT HEADER WITH STATUS "ALLOCATING"
1430
CHANGE DATA FRAGMENT HEADER STATUS TO "HEADER WRITTEN"
1432
INITIATE WRITING OF DATA FRAGMENT
1440
CHANGE DATA FRAGMENT HEADER STATUS TO "ALLOCATED"
1442
WRITE SEQUENCE TABLE ENTRY WITH STATUS "VALID"
1450
B

Figure 14

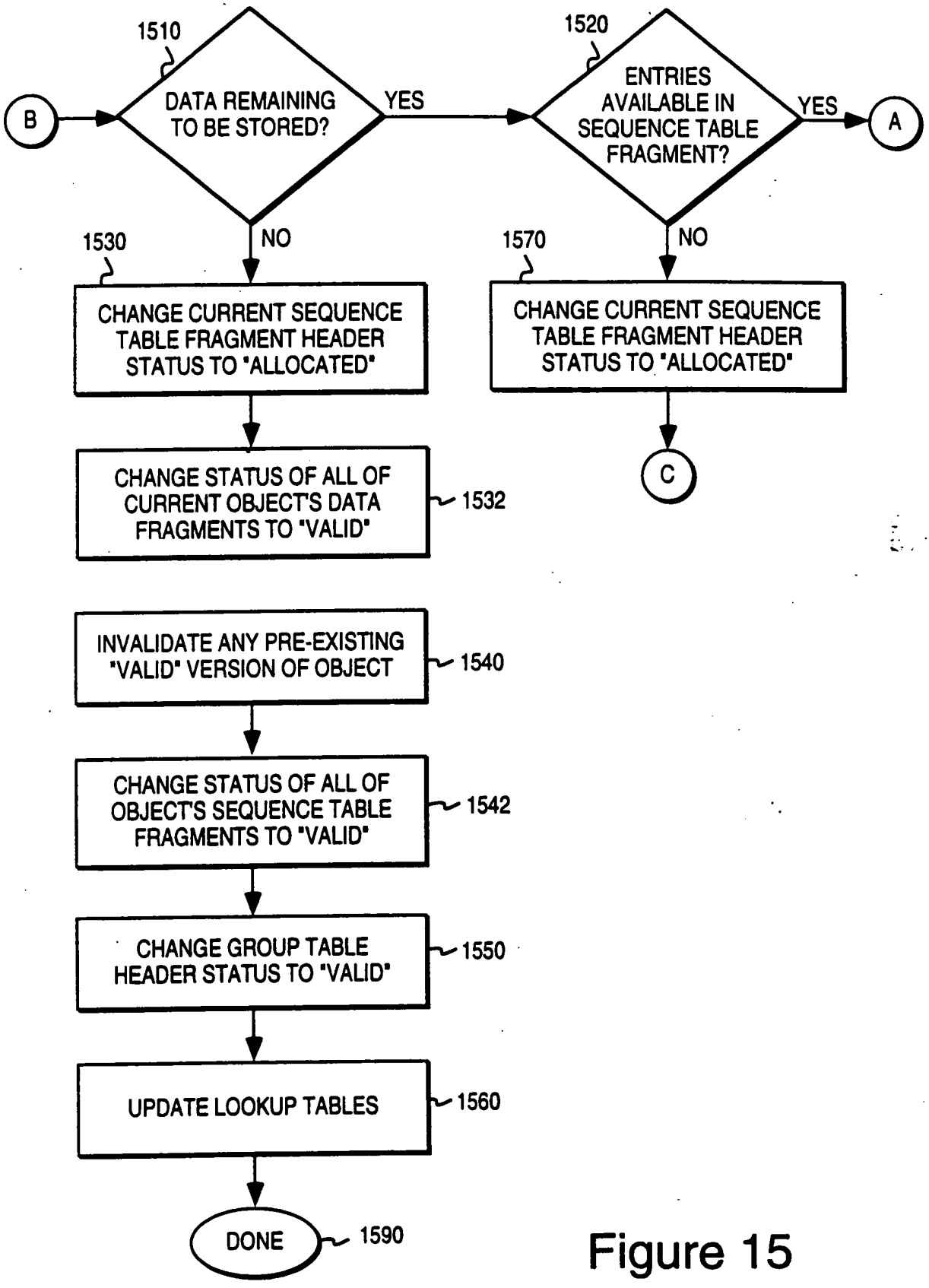

1510
DATA REMAINING TO BE STORED?
YES
1520
ENTRIES AVAILABLE IN SEQUENCE TABLE FRAGMENT?
YES
A
B
NO
1530
CHANGE CURRENT SEQUENCE TABLE FRAGMENT HEADER STATUS TO "ALLOCATED"
CHANGE STATUS OF ALL OF CURRENT OBJECT'S DATA FRAGMENTS TO "VALID"
1532
INVALIDATE ANY PRE-EXISTING "VALID" VERSION OF OBJECT
1540
CHANGE STATUS OF ALL OF OBJECT'S SEQUENCE TABLE FRAGMENTS TO "VALID"
1542
CHANGE GROUP TABLE HEADER STATUS TO "VALID"
1550
UPDATE LOOKUP TABLES
1560
DONE
1590
NO
1570
CHANGE CURRENT SEQUENCE TABLE FRAGMENT HEADER STATUS TO "ALLOCATED"
C

Figure 15

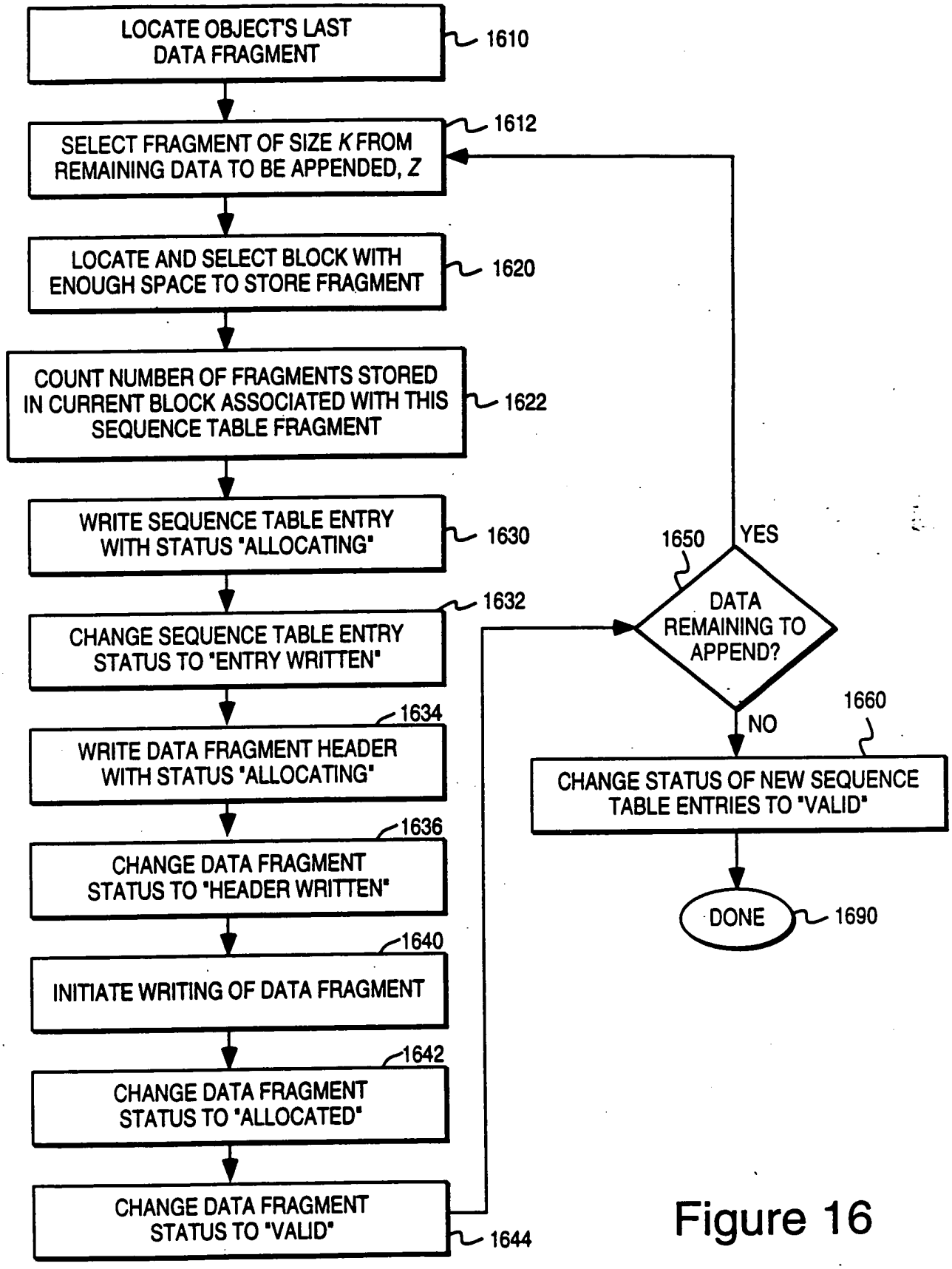

LOCATE OBJECT'S LAST DATA FRAGMENT
1610
SELECT FRAGMENT OF SIZE K FROM REMAINING DATA TO BE APPENDED, Z
1612
LOCATE AND SELECT BLOCK WITH ENOUGH SPACE TO STORE FRAGMENT
1620
COUNT NUMBER OF FRAGMENTS STORED IN CURRENT BLOCK ASSOCIATED WITH THIS SEQUENCE TABLE FRAGMENT
1622
WRITE SEQUENCE TABLE ENTRY WITH STATUS "ALLOCATING"
1630
CHANGE SEQUENCE TABLE ENTRY STATUS TO "ENTRY WRITTEN"
1632
WRITE DATA FRAGMENT HEADER WITH STATUS "ALLOCATING"
1634
CHANGE DATA FRAGMENT STATUS TO "HEADER WRITTEN"
1636
INITIATE WRITING OF DATA FRAGMENT
1640
CHANGE DATA FRAGMENT STATUS TO "ALLOCATED"
1642
CHANGE DATA FRAGMENT STATUS TO "VALID"
1644
1650
DATA REMAINING TO APPEND?
YES
NO
1660
CHANGE STATUS OF NEW SEQUENCE TABLE ENTRIES TO "VALID"
DONE
1690

Figure 16

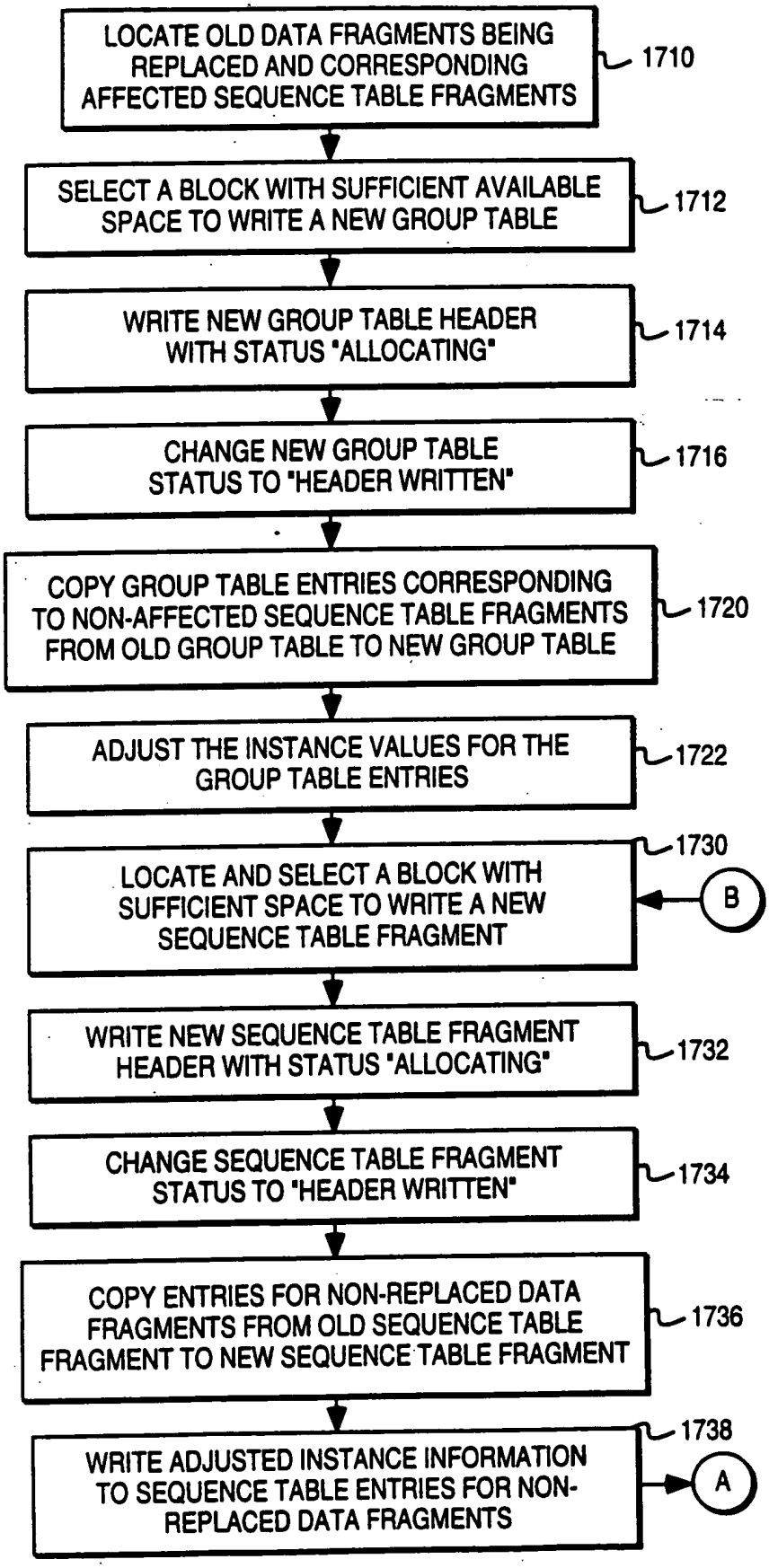

LOCATE OLD DATA FRAGMENTS BEING REPLACED AND CORRESPONDING AFFECTED SEQUENCE TABLE FRAGMENTS
1710
SELECT A BLOCK WITH SUFFICIENT AVAILABLE SPACE TO WRITE A NEW GROUP TABLE
1712
WRITE NEW GROUP TABLE HEADER WITH STATUS "ALLOCATING"
1714
CHANGE NEW GROUP TABLE STATUS TO "HEADER WRITTEN"
1716
COPY GROUP TABLE ENTRIES CORRESPONDING TO NON-AFFECTED SEQUENCE TABLE FRAGMENTS FROM OLD GROUP TABLE TO NEW GROUP TABLE
1720
ADJUST THE INSTANCE VALUES FOR THE GROUP TABLE ENTRIES
1722
1730
LOCATE AND SELECT A BLOCK WITH SUFFICIENT SPACE TO WRITE A NEW SEQUENCE TABLE FRAGMENT
B
WRITE NEW SEQUENCE TABLE FRAGMENT HEADER WITH STATUS "ALLOCATING"
1732
CHANGE SEQUENCE TABLE FRAGMENT STATUS TO "HEADER WRITTEN"
1734
COPY ENTRIES FOR NON-REPLACED DATA FRAGMENTS FROM OLD SEQUENCE TABLE FRAGMENT TO NEW SEQUENCE TABLE FRAGMENT
1736
1738
WRITE ADJUSTED INSTANCE INFORMATION TO SEQUENCE TABLE ENTRIES FOR NON-REPLACED DATA FRAGMENTS
A

Figure 17

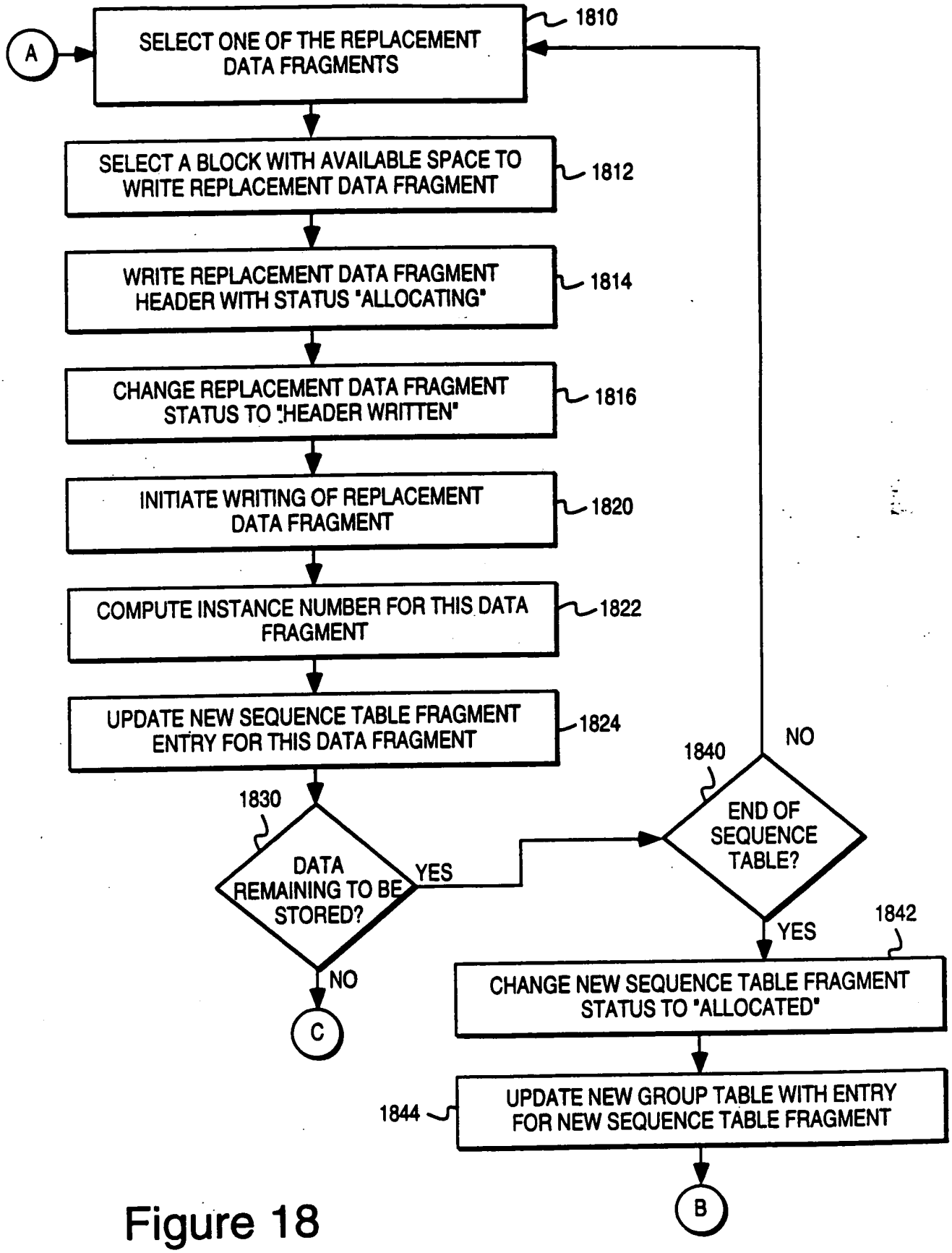

A
SELECT ONE OF THE REPLACEMENT DATA FRAGMENTS
1810
SELECT A BLOCK WITH AVAILABLE SPACE TO WRITE REPLACEMENT DATA FRAGMENT
1812
WRITE REPLACEMENT DATA FRAGMENT HEADER WITH STATUS "ALLOCATING"
1814
CHANGE REPLACEMENT DATA FRAGMENT STATUS TO "HEADER WRITTEN"
1816
INITIATE WRITING OF REPLACEMENT DATA FRAGMENT
1820
COMPUTE INSTANCE NUMBER FOR THIS DATA FRAGMENT
1822
UPDATE NEW SEQUENCE TABLE FRAGMENT ENTRY FOR THIS DATA FRAGMENT
1824
1830
DATA REMAINING TO BE STORED?
YES
NO
C
1840
END OF SEQUENCE TABLE?
NO
YES
1842
CHANGE NEW SEQUENCE TABLE FRAGMENT STATUS TO "ALLOCATED"
1844
UPDATE NEW GROUP TABLE WITH ENTRY FOR NEW SEQUENCE TABLE FRAGMENT
B

Figure 18

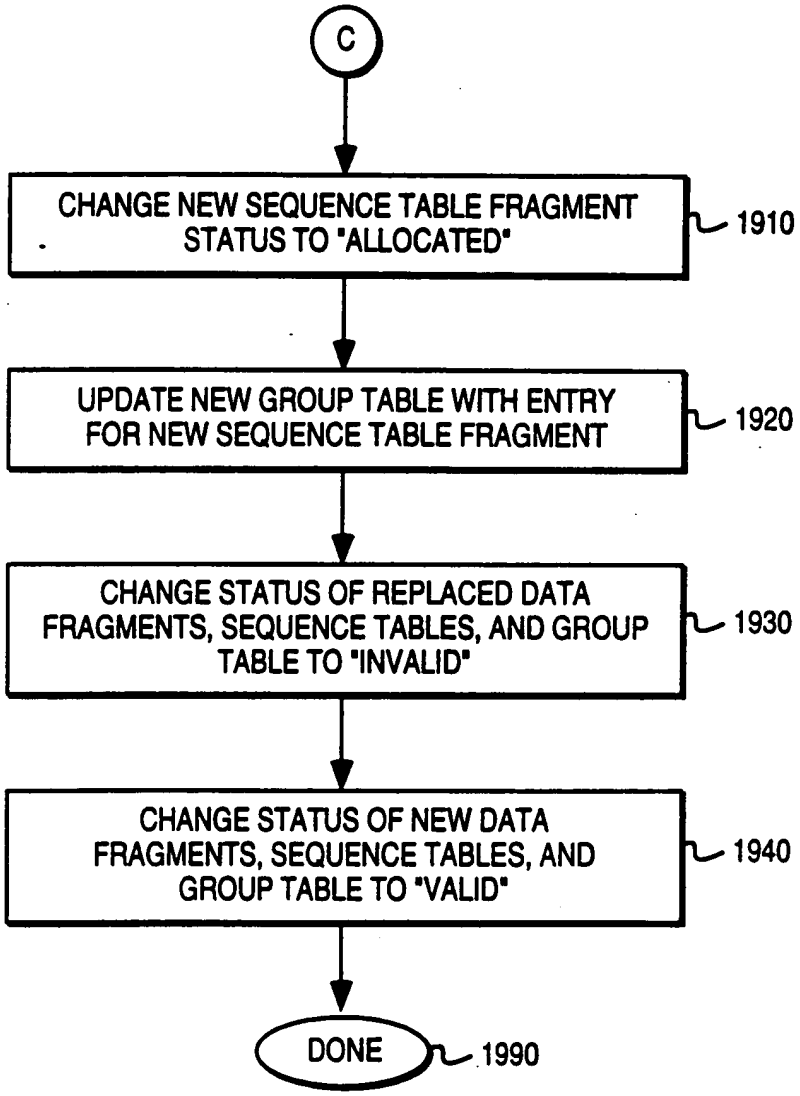

C
CHANGE NEW SEQUENCE TABLE FRAGMENT STATUS TO "ALLOCATED"
1910
UPDATE NEW GROUP TABLE WITH ENTRY FOR NEW SEQUENCE TABLE FRAGMENT
1920
CHANGE STATUS OF REPLACED DATA FRAGMENTS, SEQUENCE TABLES, AND GROUP TABLE TO "INVALID"
1930
CHANGE STATUS OF NEW DATA FRAGMENTS, SEQUENCE TABLES, AND GROUP TABLE TO "VALID"
1940
DONE
1990

Figure 19

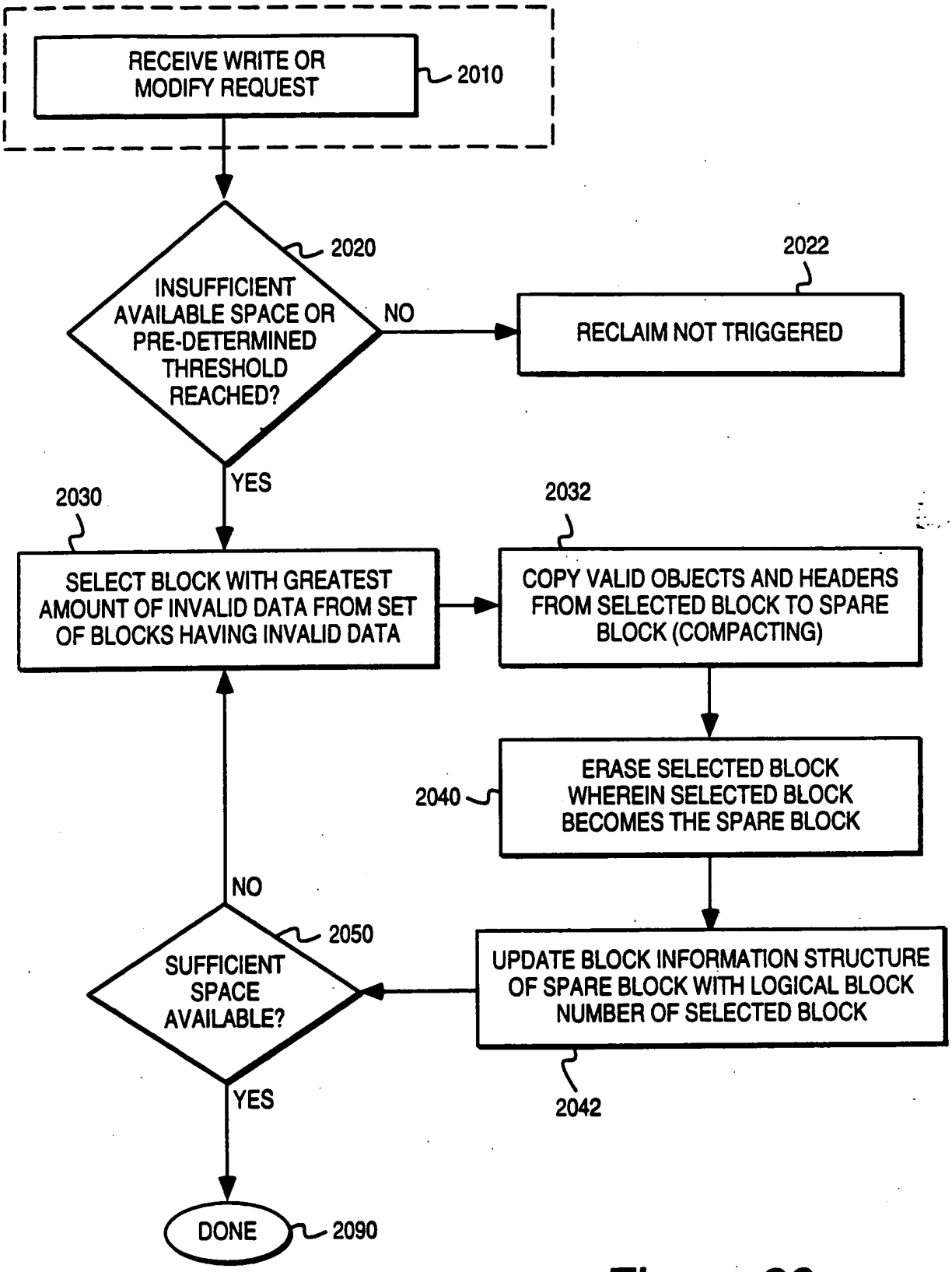

RECEIVE WRITE OR MODIFY REQUEST
2010
INSUFFICIENT AVAILABLE SPACE OR PRE-DETERMINED THRESHOLD REACHED?
2020
NO
2022
RECLAIM NOT TRIGGERED
YES
2030
SELECT BLOCK WITH GREATEST AMOUNT OF INVALID DATA FROM SET OF BLOCKS HAVING INVALID DATA
2032
COPY VALID OBJECTS AND HEADERS FROM SELECTED BLOCK TO SPARE BLOCK (COMPACTING)
ERASE SELECTED BLOCK WHEREIN SELECTED BLOCK BECOMES THE SPARE BLOCK
2040
UPDATE BLOCK INFORMATION STRUCTURE OF SPARE BLOCK WITH LOGICAL BLOCK NUMBER OF SELECTED BLOCK
2042
NO
SUFFICIENT SPACE AVAILABLE?
2050
YES
DONE
2090

Figure 20

005360 - 062060

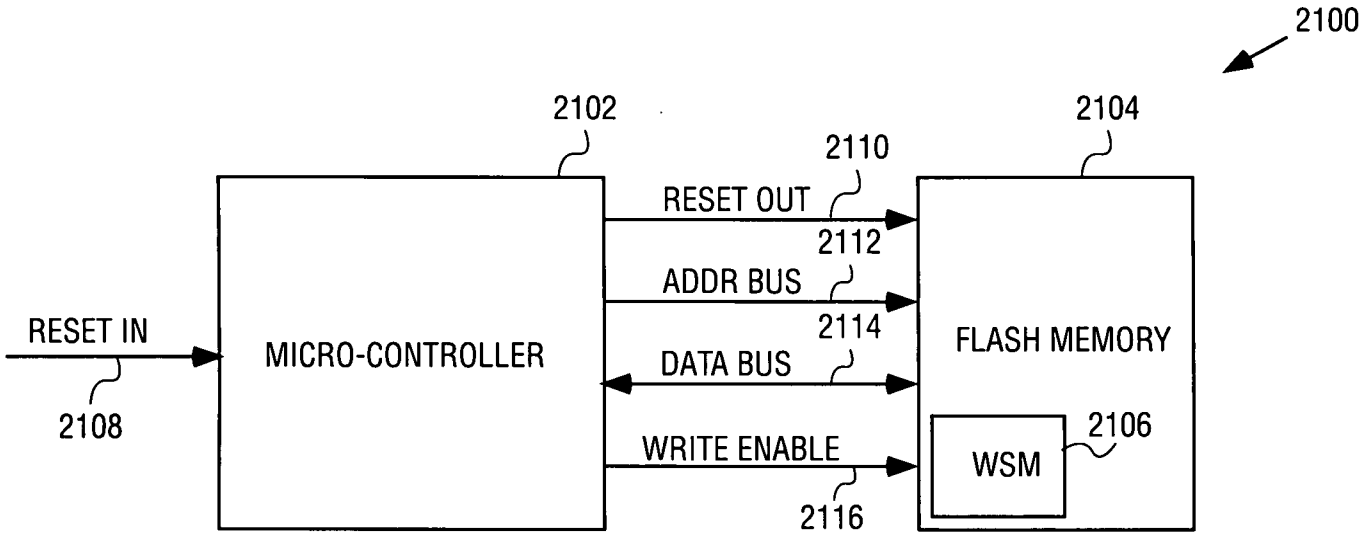


FIG. 21

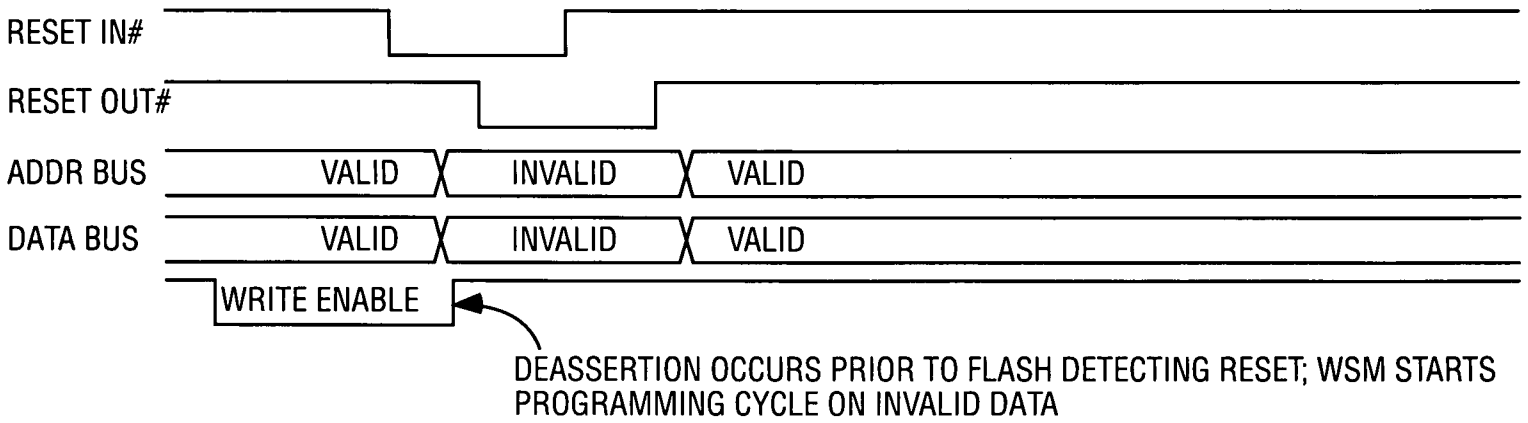


FIG. 22

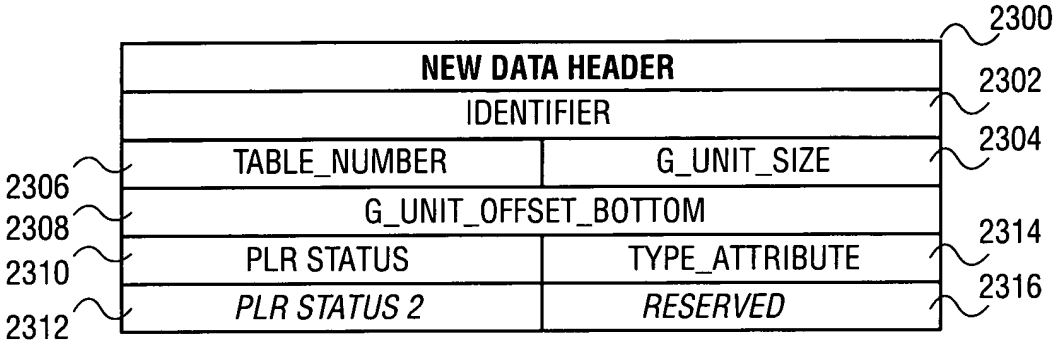

2300
NEW DATA HEADER
2302
IDENTIFIER
2304
TABLE_NUMBER
G_UNIT_SIZE
2306
2308
G_UNIT_OFFSET_BOTTOM
2314
2310
PLR STATUS
TYPE_ATTRIBUTE
2316
2312
PLR STATUS 2
RESERVED

FIG. 23

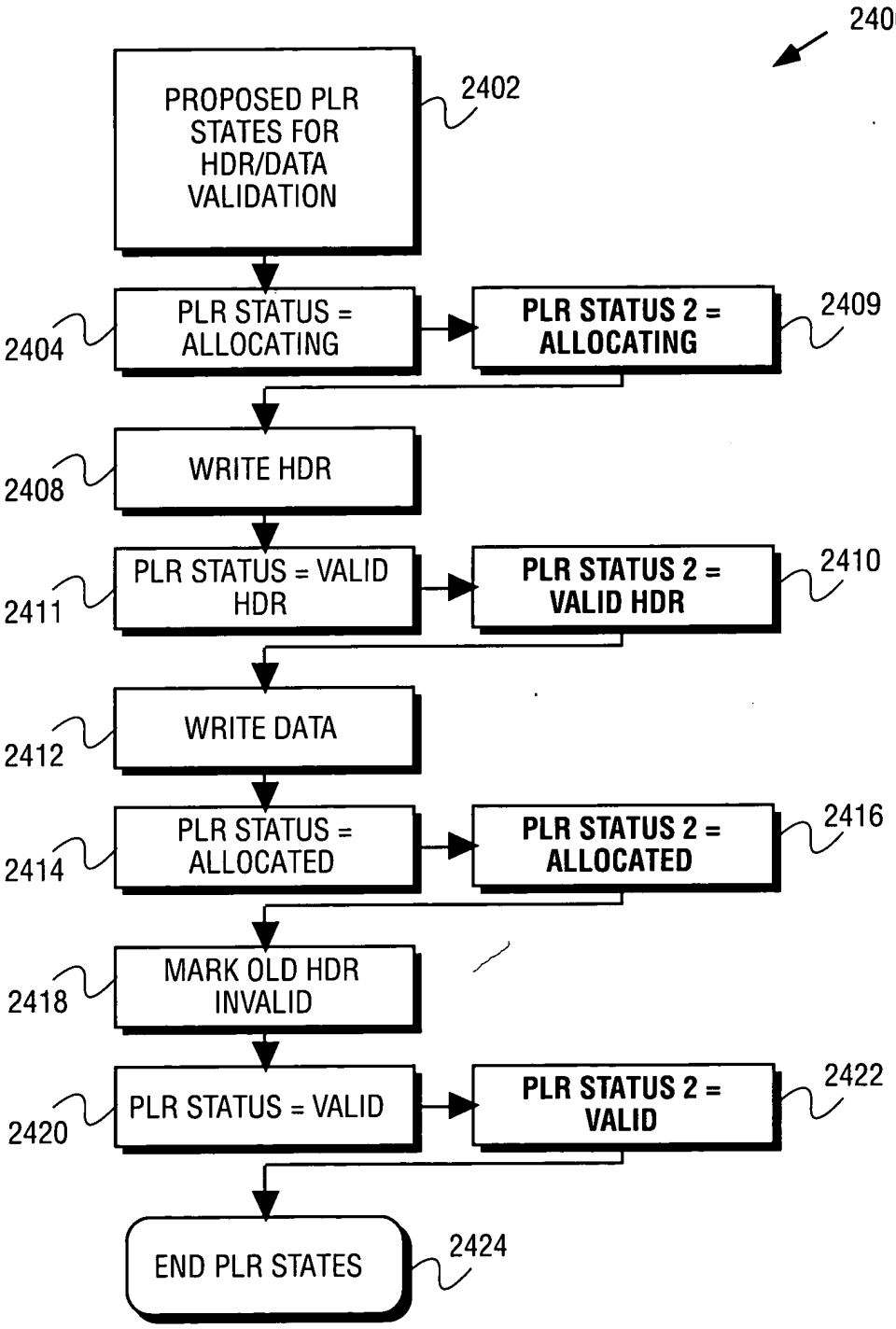

2400
PROPOSED PLR STATES FOR HDR/DATA VALIDATION
2402
PLR STATUS = ALLOCATING
2404
PLR STATUS 2 = ALLOCATING
2409
WRITE HDR
2408
PLR STATUS = VALID HDR
2411
PLR STATUS 2 = VALID HDR
2410
WRITE DATA
2412
PLR STATUS = ALLOCATED
2414
PLR STATUS 2 = ALLOCATED
2416
MARK OLD HDR INVALID
2418
PLR STATUS = VALID
2420
PLR STATUS 2 = VALID
2422
END PLR STATES
2424

FIG. 24